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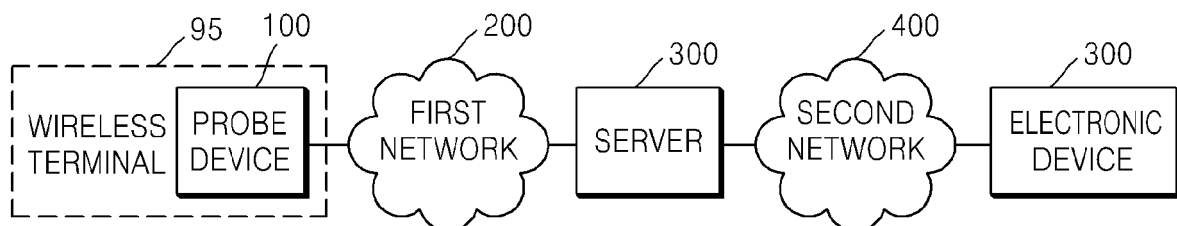
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(54) **Probe device, server, system for diagnosing ultrasound image, and method of processing ultrasound image**

(57) A probe device, a server, a system for diagnosing an ultrasound image, and a method of processing an ultrasound image. The system includes: a probe device for transmitting an echo signal received from a transducer to a server; a server for executing an ultrasound image

diagnostic application. Ultrasound image data is generated by using the echo signal received from the probe device; and an electronic device including a display unit for receiving and displaying the ultrasound image data generated by the ultrasound image diagnostic application of the server.

**FIG. 1**



## Description

**[0001]** The present invention relates to a probe device, a server, a system for diagnosing an ultrasound image, and a method of processing an ultrasound image. More particularly, the present invention relates to a probe device, server, a system for diagnosing an ultrasound image, and a method of processing an ultrasound image, all of which are based on cloud computing connected to a network.

**[0002]** Ultrasonic waves are sound waves in a frequency domain higher than an audible frequency domain (audible frequencies typically ranging from 20 Hz to 20 kHz). Accordingly, ultrasonic waves cannot be heard by people. A typical system for diagnosing an ultrasound image transmits an ultrasonic signal from a point of transmission exterior to the body, which penetrates into tissues or organs in a human body by using the human body as a medium, and obtains an image of the tissues or organs by using information about the ultrasonic signal reflected from the tissues or organs in the human body.

**[0003]** Such ultrasonic image diagnosing systems are typically small, inexpensive, and display the image in real-time. Also, since the system has high stability as it is not exposed to X-rays or the like, the system may be widely used with other image diagnostic apparatuses, such as an X-ray diagnostic apparatus, a computerized tomography (CT) scanner, a magnetic resonance image (MRI) apparatus, and a nuclear medicine diagnostic apparatus.

**[0004]** The ultrasonic system may comprise a cart type system or a hand carried ultrasonic (HCU) type system. Due to its larger size, it is more difficult to use a cart type system than an HCU type in emergency situations or common homes. Meanwhile, an HCU type system may be easier to use in emergency situations, etc., than the cart type because the HCU type is manufactured by using a transducer or an apparatus for processing ultrasound image information in a portable terminal shape. However, the quality of an ultrasound image of the HCU type system suffers, particularly when compared with the cart type systems, primarily due to limitation in size of a portable terminal and constraints on power usage, as the portable terminal uses rechargeable batteries.

**[0005]** The present invention provides a probe device, a server, a system for diagnosing an ultrasound image, and a method of processing an ultrasound image. Embodiments of the present invention overcome limitations in terms of compactness and slimness. Also manufacturing costs may be remarkably reduced. Embodiments of devices for diagnosing an ultrasound image in accordance with the method, system and apparatus according to the present invention address the need to be compact and slim in order to increase the portability of the device and to overcome the problems that have heretofore prohibited development of such a high performance processing apparatus that processes a high resolution image signal or performs various functions of the device.

**[0006]** According to an exemplary aspect of the present invention, there is provided a probe device preferably including: a pulse generator including a pulser that generates a pulse signal; a transducer that converts the pulse signal generated by the pulse generator to ultrasonic waves, and converts received ultrasonic waves to an electrical signal; an analog signal processor that generates an echo signal by using the electrical signal converted by the transducer; and a probe communicator that communicates through a network with a server that executes an ultrasound image diagnostic application requested by an electronic device, and transmits the echo signal generated by the analog signal processor to the server.

**[0007]** The probe device may preferably further include a coupling unit that performs a process of interlocking (coupling) the probe device with the ultrasound image diagnostic application executed by the server.

**[0008]** The pulse generator may preferably further include a transmitter beam former that focuses ultrasonic waves output from the transducer.

**[0009]** The analog signal processor may preferably include: an amplifier that amplifies the electrical signal converted by the transducer; and an analog/digital (A/D) converter that converts the electrical signal amplified by the amplifier to a digital echo signal.

**[0010]** The analog signal processor may preferably further include a receiver beam former that focuses the digital echo signal converted by the A/D converter.

**[0011]** The analog signal processor may preferably further include a compressor that compresses a data size of the digital echo signal converted by the A/D converter.

**[0012]** The probe communicator may preferably include at least one of a mobile communication module that directly connects to the network, a wireless Internet module, a wired Internet module, and a local area communication module, or may include a communication interface connecting to the network through an external communication module.

**[0013]** The probe device may preferably further include a user input unit that receives input from a user.

**[0014]** According to another exemplary aspect of the present invention, there is provided a server preferably including: a server communicator that communicates with a probe device and an electronic device through a network; a data storage unit that stores an ultrasound image diagnostic application; and an operation unit that executes the ultrasound image diagnostic application when the electronic device requests to execute the ultrasound image diagnostic application, wherein the operation unit generates ultrasound image data by using an echo signal transmitted from the electronic device, and transmits the generated ultrasound image data to the electronic device.

**[0015]** According to another exemplary aspect of the present invention, there is provided a system for diagnosing an ultrasound image, the system preferably including: a probe device that transmits an echo signal to

a server through a network; a server that executes an ultrasound image diagnostic application, wherein ultrasound image data is generated by using the echo signal received from the probe device; and an electronic device including a display unit that receives through a network and displays the ultrasound image data generated by the ultrasound image diagnostic application of the server.

**[0016]** The ultrasound image diagnostic application of the server may preferably execute a transmitter beam forming process for focusing the echo signal.

**[0017]** The ultrasound image diagnostic application of the server may execute a receiver beam forming process that focuses the digital echo signal converted by the A/D converter. The degree of focus can be according to a predetermined algorithm that determines focus of the digital echo signal.

**[0018]** The probe device may include a communication module directly connecting to the network, or may directly connect to the network. Here, the communication module may be built in or removable from the probe device.

**[0019]** Alternatively, the probe device may connect to the network through the electronic device by being connected to the electronic device wirelessly or via wires. For example, the probe device may include a communication interface connected to a mobile device to connect to the mobile device wirelessly or via wires, and the mobile device may connect to the network so that the probe device indirectly connect to the network.

**[0020]** The display unit of the electronic device may display a user interface of the ultrasound image diagnostic application executed by the server.

**[0021]** The probe device may be controllable by the electronic device.

**[0022]** An ultrasound image mode of the ultrasound image diagnostic application may be selected through the electronic device.

**[0023]** In addition, the electronic device may preferably include a first electronic device and a second electronic device, which respectively receive and display ultrasound image data generated by the ultrasound image diagnostic application of the server. The ultrasound image diagnostic application executed by the server may be controlled by either of the first and second electronic devices. Alternatively, the ultrasound image diagnostic application executed by the server may be controlled by both the first and second electronic devices. The ultrasound image data or the user interface of the ultrasound image diagnostic application displayed on the first electronic device may be manipulatable by the second electronic device connected through the server. For example, the first electronic device may be operated locally by a user such as an emergency rescuer or a self-diagnosing user, adjacently located to the probe device, and the second electronic device may be operated by an image diagnostic expert remotely located away from the probe device, such as at a hospital. Here, the ultrasound image diagnostic application of the server may be executed through the first electronic device, and the second elec-

tronic device may receive and display ultrasound image data generated by the ultrasound image diagnostic application of the server. It is also possible that invention could operate on a peer-to-peer basis with a second electronic device being associated with trained medical experts, a hospital or medical center, and the second electronic device may have more processing capabilities as compared with the first device. Of course, an ultrasound image mode of the ultrasound image diagnostic application executed in the server may be selected through the second electronic device.

**[0024]** The electronic device may comprise a mobile terminal connected to a wireless network or a desktop connected to a wired or wireless network. The mobile terminal may be a mobile phone, a smart phone, a touch pad, a laptop, a digital broadcasting terminal, a personal digital assistant (PDA), a portable multimedia player (PMP), a navigation device, a tablet personal computer (PC), or a remote controller.

**[0025]** The server may perform a user authentication process on the electronic device.

**[0026]** According to another exemplary aspect of the present invention, there is provided a method of processing an ultrasound image, the method preferably including: transmitting a request for executing an ultrasound image diagnostic application from an electronic device to a server through a network; executing the ultrasound image diagnostic application by using the server according to the request of the electronic device; generating an echo signal by using the probe device; transmitting the echo signal generated by the probe device to the server; generating ultrasound image data using the server by using the received echo signal; and displaying an ultrasound image on the electronic device by receiving the ultrasound image data from the server through the network.

**[0027]** The method may preferably further include interlocking the probe device with the ultrasound image diagnostic application executed by the server.

**[0028]** The generating of the echo signal may include: converting ultrasonic waves received from a material to be examined into an electrical signal; and converting the electrical signal into a digital echo signal.

**[0029]** The generating of the echo signal may further include compressing a data size of the digital echo signal.

**[0030]** A transmitter beam forming process of focusing ultrasonic waves output from a transducer of the probe device may be performed in the probe device. A receiver beam forming process of focusing ultrasonic waves output from a transducer of the probe device may be performed by the ultrasound image diagnostic application of the server.

**[0031]** The method may preferably further include displaying a user interface of the ultrasound image diagnostic application executed by the server and output to the electronic device, on the electronic device.

**[0032]** The probe device may be controllable by the electronic device.

**[0033]** An ultrasound image mode of the ultrasound image diagnostic application may be selected through the electronic device.

**[0034]** The method may preferably further include performing user authentication on the electronic device when the electronic device connects to the server or when the ultrasound image diagnostic application is executed by an operation unit of the server.

**[0035]** The method may preferably further include, when the electronic device that transmitted the request to execute the ultrasound image diagnostic application to the server is a first electronic device, preparing a second electronic device for displaying the ultrasound image by receiving the ultrasound image data from the server. The server may transmit the ultrasound image data to the second electronic device according to a request of the first or second electronic device. The method may preferably further include performing user authentication on the second electronic device, when the second electronic device connects to the server or to the ultrasound image diagnostic application.

**[0036]** The ultrasound image diagnostic application executed by the server may be controllable by either of the first and second electronic devices. The ultrasound image diagnostic application executed by the server may be controllable by both of the first and second electronic devices.

**[0037]** The ultrasound image or the user interface of the ultrasound image diagnostic application displayed on the first electronic device may be manipulatable from the second electronic device connected through the server. The ultrasound image or the user interface of the ultrasound image diagnostic application displayed on the second electronic device may be manipulatable from the first electronic device connected through the server.

#### BRIEF DESCRIPTION OF THE DRAWINGS

**[0038]** The above and other exemplary features and advantages of the presently claimed invention will become more apparent to a person of ordinary skill in the art by describing in detail exemplary embodiments thereof with reference to the attached drawings in which:

FIG. 1 is a diagram of a system for diagnosing an ultrasound image, according to an exemplary embodiment of the present invention;

FIG. 2 is a block diagram of a probe device according to an exemplary embodiment of the present invention;

FIG. 3 is a block diagram of a server according to an exemplary embodiment of the present invention;

FIG. 4 is a block diagram of an electronic device according to an exemplary embodiment of the present invention;

FIG. 5 is an example of a user interface displayed on the electronic device of FIG. 4;

FIG. 6 is a flowchart for describing operations of a

system for diagnosing an ultrasound image, according to an exemplary embodiment of the present invention;

FIG. 7 is a block diagram of a probe device according to another exemplary embodiment of the present invention;

FIG. 8 is a block diagram of a probe device according to another exemplary embodiment of the present invention;

FIG. 9 is a block diagram of a probe device according to another exemplary embodiment of the present invention;

FIG. 10 is a diagram of a system for diagnosing an ultrasound image, according to another exemplary embodiment of the present invention;

FIG. 11 is a flowchart illustrating a method of processing an ultrasound image, according to an exemplary embodiment of the present invention;

FIG. 12 is a diagram of a system for diagnosing an ultrasound image, according to another exemplary embodiment of the present invention; and

FIG. 13 is a diagram of a system for diagnosing an ultrasound image, according to another exemplary embodiment of the present invention.

#### DETAILED DESCRIPTION OF THE INVENTION

**[0039]** Hereinafter, the present invention will be described more fully with reference to the accompanying drawings, in which exemplary embodiments of the invention are shown. In the drawings, like reference numerals denote like elements, and the sizes and thicknesses of elements may be exaggerated for clarity. As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items. Expressions such as "at least one of," when preceding a list of elements, modify the entire list of elements and do not modify the individual elements of the list. The examples provided herein are merely illustrative to assist a person of ordinary skill in the art with an understanding and appreciation of the claimed invention, and the appended claims are in no way limited to the examples provided herein.

**[0040]** FIG. 1 is a diagram of a system for diagnosing an ultrasound image, according to an exemplary embodiment of the present invention.

**[0041]** Referring now to FIG. 1, the system may preferably include a probe device 100 for transmitting and receiving ultrasonic waves, a server 300 for executing an ultrasound image diagnostic application for generating an ultrasound image by using echo data received by the probe device 100, and an electronic device 500 for providing a user interface of the ultrasound image diagnostic application executed in the server 300. There may be one or more electronic devices 500.

**[0042]** The probe device 100 which may optionally be part of a wireless terminal 95, such as a mobile communication terminal and the server 300 transmit and receive data through a first network 200. Also, the server 300

and the electronic device 500 transmit and receive data through a second network 400. The first and second networks may include an Internet network, a mobile communication network, or the like.

**[0043]** The first and second networks 200 and 400 may be the same or different kinds of networks according to usage specifications. For example, the second network could be 802.11, WIFI, or WLAN with the server based for example, at a medical facility. While it is preferred and understood that cloud computing is used, it is also within the spirit and scope of the claimed invention that the electronic device 500 could be connected to the second server via wire, such as Ethernet. A person of ordinary skill in the art should understand and appreciate that the claimed invention may include the use of a proxy server in communication with server 300.

**[0044]** FIG. 2 is a block diagram of the probe device 100 according to the current exemplary embodiment of the present invention.

**[0045]** Referring now to FIG. 2, the probe device 100 preferably includes a transducer 110, a pulse generator 120, an analog signal processor 130, a coupling unit 140, and a probe communicator 150.

**[0046]** The transducer 110 preferably includes a plurality of conversion elements that convert and transmit a pulse signal generated by the pulse generator 120 to ultrasonic waves, and convert reflected ultrasonic waves to an analog echo signal, i.e., an electronic signal. The conversion elements may be formed of a piezoelectric material, and may have a one dimensional (1D) or two dimensional (2D) arrangement structure. The transducer 110 generates ultrasonic waves upon receiving a high voltage electric pulse from the pulse generator 120, and converts ultrasonic waves reflected from inside a body of a person to be examined back to an analog electrical signal (analog echo signal).

**[0047]** The pulse generator 120 includes a pulser 121 for generating a high voltage electric pulse signal.

**[0048]** The analog signal processor 130 generates a digital echo signal (echo data) by using the analog echo signal converted by the transducer 110. The analog signal processor 130 may preferably include an amplifier 131 amplifying the analog echo signal converted by the transducer 110, and an analog/digital (A/D) converter 132 converting the analog echo signal to a digital format.

**[0049]** The amplifier 131 may preferably include, for example, a low noise amplifier (LNA) for satisfactory sensitivity, or a time gain compensator (TGC) for adjusting a gain according to time to compensate for signal attenuation that increased while passing through a human body.

**[0050]** Besides the elements shown in FIG. 2, the probe device 100 may further include various elements, such as a battery, a high voltage multiplexer (HVMUX), an LNA, and a transmit/receive (T/R) switch, which are well-known to one of ordinary skill in the art.

**[0051]** The coupling unit 140 may perform a process of interlocking the probe device 100 to the ultrasound

image diagnostic application executed in the server 300 through the first network 200. For example, the interlocking of the probe device to the ultrasound image diagnostic comprises the coupling unit 140 storing identification information of the probe device 100, and thus when the probe communicator 150 connects to the server 300, the identification information of the probe device 100 is transmitted to the server 300 so that the ultrasound image diagnostic application executed in the server 300 identifies the probe device 100.

**[0052]** The probe communicator 150 may include at least one of a mobile communication module, a wireless Internet module, and a local area communication module. The mobile communication module transmits and receives a wireless signal with at least one of a base station, an external terminal, and a server in a mobile communication network, such as 2G, 3G, or 4G. The probe communicator 150 is expected to be compatible with any future network wireless protocols beyond those previously listed. The wireless internal module is a module for connecting to a wireless Internet. The local area communication module is a module for local area communication, and enables at least one wireless communication method from among the standard IEEE 802.11 of a wireless network about a wireless local area network (LAN) suggested by the Institute of Electrical and Electronics Engineers (IEEE) and a wireless LAN including partial infrared ray communication, the standard IEEE 802.15 about a wireless personal area network (PAN) including Bluetooth, ultra wideband (UWB), and Zigbee, the standard 802.16 about a metropolitan area network (MAN) or broadband wireless access (BWA) including fixed wireless access (FWA), and the standard IEEE 802.20 about mobile Internet of mobile BWA (MBWA) including Wibro and WiMAX. The probe communicator 150 may further include a wired Internet module for wired Internet access to communicate with the server 300 via wire according to user environments. The probe communicator 150 communicates with the server 300 by using at least one of the mobile communication module, the wired Internet module, the wireless Internet module, and the local area communication module, and hereinafter, the probe device 100 communicates with the server 300 without repeating a detailed communication method such as the many communication protocols mentioned hereinabove.

**[0053]** A person of ordinary skill in the art should understand and appreciate that the probe device 100 and the server 300 may communicate with each other via the first network 200. For example, the first network 200 may perform a relay function for communication linkage with a plurality of external devices, or may include a relay device (not shown) that performs a relay function for communication linkage between a peripheral device and an external communication network (or a network). The relay device may perform a function of changing a protocol, if a communication protocol of the probe device 100 constituting a relay target and a communication protocol of

the server 300 are different from each other. The relay device may be an access point, a gateway, a hotspot, a router, or a combination thereof, or a proxy. Alternatively, the probe device 100 may be directly connected to the server 300 via an ad hoc method or a Wi-Fi direct (WFD) method, without using a relay device.

**[0054]** The probe communicator 150 transmits the echo data processed by the analog signal processor 130 to the server 300 via the first network 200, and receives probe control data for controlling the probe device 100 back from the server 300.

**[0055]** The probe device 100 described above may comprise a portable wireless device for communicating with the server 300 by connecting to the first network 200 in a wireless manner.

**[0056]** The probe communicator 150 according to the current embodiment includes a communication module, such as a mobile communication module, a wired Internet module, a wireless Internet module, or a local area communication module, but the probe communicator 150 is not limited thereto. In other words, the probe communicator 150 may only include a general-purpose communication interface (not shown), such as a universal serial bus (USB) or a Bluetooth, and the communication module, such as the mobile communication module, the wired Internet module, the wireless Internet module, or the local area communication module, may be an external communication module or a part of a mobile device, such as a smart phone. In this case, the probe communicator 150 may connect to the external communication module or the mobile device wirelessly or via wires and the external communication module or the mobile device may connect to the first network, such that the probe device 100 indirectly contact the first network 200. FIG. 3 is a block diagram of the server 300 according to the current exemplary embodiment of the present invention. Referring now to FIG. 3, the server 300 includes a server communicator 310, an operation unit 320, and a data storage unit 330. The server communication and operation unit comprise hardware and may include separate processors or microprocessors, or a single microprocessor.

**[0057]** The server communicator 310 may preferably include at least one of a mobile communication module, a wired Internet module, a wireless Internet module, and a local area communication module. Since the mobile communication module, the wired internet module, the wireless Internet module, and the local area communication module are substantially the same as those described above with respect to the probe communicator 150, details thereof will not be repeated.

**[0058]** Upon receiving a command to execute the ultrasound image diagnostic application through the server communicator 310, the operation unit 320 executes the ultrasound image diagnostic application by loading the ultrasound image diagnostic application from the data storage unit 330 into hardware such as a microprocessor controller. The ultrasound image diagnostic application includes an image processing module for generating an

ultrasound image based on ultrasonic echo data obtained from the probe device 100. Also, the ultrasound image diagnostic application may provide a user interface to the electronic device 500. The user interface may not only include a menu related to processing an ultrasound image, but may also preferably include a control menu, etc. for controlling the probe device 100. Also, the ultrasound image diagnostic application may include a module for managing various types of diagnostic data related to an ultrasound image of a person to be examined. In addition, the ultrasound image diagnostic application may preferably further include an authentication module for the probe device 100 and/or the electronic device 500. The operation unit 320 may perform a process of identifying the probe device 100 to be connected, by comparing identification information transmitted from the probe device 100 and identification information of the probe device 100, which is pre-stored in the data storage unit 330. Also, the operation unit 320 may perform a user authentication process on the electronic device 500. The user authentication process may be performed on the electronic device 500 when the electronic device 500 is connected to the server 300 or when the ultrasound image diagnostic application is executed.

**[0059]** The data storage unit 330, which comprises a non-transitory machine readable medium, may store an execution program of the ultrasound image diagnostic application or may temporarily store data processed in the ultrasound image diagnostic application, such as digital echo data transmitted from the probe device 100 or ultrasound image data processed from the digital echo data. Also, the data storage unit 330 may store the identification information of the probe device 100 and identification information of the electronic device 500. Furthermore, the data storage unit 330 may store information about the person to be examined including identification information (ID, a resident registration number, a name, an address, a phone number, etc.), a diagnostic result of the person to be examined, etc. The data storage unit 330 may include a storage medium of at least one type, from among a flash memory type, a hard disk type, a multimedia card micro type, a card type memory (for example, a secure digital (SD) card or an extreme digital (XD) card), a random access memory (RAM) type, a static RAM (SRAM) type, a read-only memory (ROM) type, an electrically erasable programmable read-only memory (EEPROM) type, a programmable read-only memory (PROM) type, a magnetic memory type, a magnetic disk type, and an optical disk type, just to name some non-limiting examples. Such a data storage unit 330 may exist as a separate storage server connected to a network.

**[0060]** The server 300 may be understood as a cloud computing service server processor for executing an application requested by a client, such as the probe device 100 or the electronic device 500, through the first and second networks 200 and 400.

**[0061]** FIG. 4 is a block diagram of the electronic device 500 according to the current embodiment of the present

invention. Referring now to FIGS. 1 and 4, the electronic device 500 may include a terminal communicator 510 for communicating with the server 300, a display unit 520 for displaying a screen of an image diagnostic application executed in the server 300, a user input unit 530 for inputting a manipulation menu of the image diagnostic application executed in the server 300, and a terminal controller 540 for generating a control message, or the like.

**[0062]** The terminal communicator 510 may preferably include at least one of a mobile communication module, a wired Internet module, a wireless Internet module, and a local area communication module. The mobile communication module, the wired Internet module, the wireless Internet module, and the local area communication module are substantially the same as those described above with respect to the probe communicator 150, and thus, details thereof are not repeated.

**[0063]** The display unit 520 displays the screen of the image diagnostic application executed in the server 300. For example, the screen of the image diagnostic application may be a user interface displayed with an ultrasound image processed by the server 300 and a manipulation menu for selecting a mode (for example, a brightness (B) mode, a Doppler (D) mode, a color (C) mode, a motion (M) mode, and an elastic mode) for processing an ultrasound image. The display unit 520 may include at least one of a liquid crystal display (LCD), a thin film transistor-liquid crystal display (TFT-LCD), an organic light-emitting diode (OLED), a flexible display, a transparent display, and a three dimensional (3D) display. The claimed invention is not limited to the types of aforementioned displays, as these are merely exemplary or preferable.

**[0064]** The user input unit 530 generates key input data that is input to manipulate the image diagnostic application executed in the server 300 by a user. The user input unit 530 may include a key pad or a touch pad (static pressure or electrostatic for example). Specifically, a touch screen is formed when the user input unit 530 that is a touch pad type forms a mutual layer structure with the display unit 520. The claimed invention is not limited by the types of touch screens disclosed herein, which are provided only for illustrative purposes.

**[0065]** FIG. 5 is an example of a user interface displayed on the display unit 520 of the electronic device 500 of FIG. 4. Referring to FIG. 5, the display unit 520 may display an ultrasound image 521 obtained by outputting ultrasound image data generated by the server 300, information 522 about a user, information 523 about an ultrasound image processing mode, and identification information 524 about the probe device 100. When the user input unit 530 is activated with an input method such as a touch screen method, menus for the information 522, 523, and 524 may be directly manipulated to manipulate the image diagnostic application including the ultrasound image processing mode or to control the probe device 100.

**[0066]** Referring back to FIG. 4, the terminal controller

540 may generate a control message for controlling the image diagnostic application executed in the server 300, according to key input data input from the user input unit 530. The control messages can be communicated through a browser. More particularly, the wireless device electronic device 500 may have an "app", or a graphic user interface that has a link to activate the image diagnostic application. The electronic device 500 may further include a memory (not shown) for temporarily storing image data of the image diagnostic application input from the server 300.

**[0067]** As described above, the electronic device 500 according to the current exemplary embodiment operates as an input and output unit of the server 300 to display a screen for executing the image diagnostic application of the server 300 and input a manipulation menu. The electronic device 500 may be a mobile terminal connected to a wireless network or a desktop connected to a wired or wireless network. Examples of the mobile terminal include a mobile phone, a smart phone, a touch pad, a laptop, a digital broadcasting terminal, a personal digital assistant (PDA), a portable multimedia player (PMP), a navigation device, a tablet personal computer (PC), and a remote controller, just to name some non-limiting possibilities. Since processing of an ultrasound image with a high load is performed by the image diagnostic application of the server 300, the electronic device 500 does not need high performance and may be sufficient enough to display a process result of the server 300.

**[0068]** Next, operations of a system for diagnosing an ultrasound image, according to an embodiment of the present invention will be described.

**[0069]** FIG. 6 is a flowchart for describing operations of a system for diagnosing an ultrasound image, according to an exemplary embodiment of the present invention. Referring to FIGS. 1 through 6, the system performs the following operations.

**[0070]** First, the electronic device 500 connects to the server 300, in operation S610. The electronic device 500 may comprise a terminal possessed by a medical image expert, such as a doctor, a nurse, a medical laboratory technologist, or an emergency rescuer, or a terminal possessed by a person to be examined. In the event where a person to be examined is using the probe, it could be plugged into or be in communication with the electronic device 500 wirelessly through a local communication protocol. The probe can also be integrated in the electronic device in such an instance. When a message requesting to execute the ultrasound image diagnostic application is transmitted from the electronic device 500 to the server 300, the server 300 executes the ultrasound image diagnostic application, in operation S620.

**[0071]** User authentication may be additionally performed in operation S630 while performing the ultrasound image diagnostic application. Operation S630 may be performed, while executing the ultrasound image diagnostic application, as the server 300 requests the electronic device 500 for identification information of a

user, the electronic device 500 transmits input manipulation of the user or user identification information pre-input in the electronic device 500 to the server 300, and the server 300 compares the received identification information and the pre-stored user identification information. In some cases, the user authentication may be performed by using identification information of the electronic device 500. FIG. 6 shows that operation S630 is performed while executing the ultrasound image diagnostic application, but alternatively, operation S630 may be performed when the electronic device 500 initially connects to the server 300.

**[0072]** Next, the probe device 100 is turned on, and interlocked to the ultrasound image diagnostic application of the server 300, in operation S640. When the probe device 100 is turned on, the coupling unit 140 inside the probe device 100 transmits its identification information to the server 300, and the ultrasound image diagnostic application executed in the server may identify the probe device 100 based on the received identification information. A plurality of the probe device 100 may be connected to the server 300, and in this case, the ultrasound image diagnostic application of the server 300 may display the identification information of communicable probe devices 100 on the display unit 520 of the electronic device 500 for the user to select the probe device 100.

**[0073]** Then, the probe device 100 transmits digital echo data generated from reflected ultrasonic waves to the server 300, in operation S650. The ultrasound image diagnostic application of the server 300 generates ultrasound image data by using the echo data received from the probe device 100, in operation S660.

**[0074]** A process of processing the ultrasound image performed by the ultrasound image diagnostic application may be a well-known process. For example, the process may include a transmitter beam forming process, a receiver beam forming process, a filtering process, and a scan conversion process.

**[0075]** The transmitter beam forming process is a signal processing process of focusing ultrasonic waves output from the transducer 110 so as to view reflection characteristics of a tissue at a desired location, and determines pulse signals to be applied to each of conversion elements of the transducer 110 by considering locations of the conversion elements and a focus point of the output ultrasonic waves.

**[0076]** The receiver beam forming process is a process of focusing a received ultrasound echo signal to view reflection characteristics of a tissue at a desired location. As an example of the receiver beam forming process, an adaptive weight beamforming technique of assigning weights to echo signals converted by the conversion elements of the transducer 110 of FIG. 2 and performing a delay and sum (DAS) operation is well-known.

**[0077]** The filtering process may be bandpass filtering, and not only reduces noise, but is also used to process an ultrasound image using a reference frequency (provides excellent penetration) or secondary harmonic

waves (provides excellent resolution due to excellent tissue classifying characteristics).

**[0078]** The scan conversion process is a process of converting a coordinate system of raw data into a coordinate system used in the display unit 520 of the electronic device 500.

**[0079]** The ultrasound image diagnostic application may employ various algorithms for a digital processing path to extract a clear image. For example, the ultrasound image diagnostic application may employ algorithms such as match filtering, time frequency compensation, echo line averaging, speckle reduction, frame smoothing, and edge detection.

**[0080]** Meanwhile, the ultrasound image diagnostic application may process the ultrasound image in at least one of a B mode, a D mode, a C mode, an M mode, and an elastic mode. Furthermore, the ultrasound image diagnostic application may process a 2D image or a 3D image.

**[0081]** More particularly, the B mode provides a black and white image used to examine tissue structure and organs. The D mode provides a speed of a moving object in a Doppler spectrum image by using a Doppler effect. The C mode provides a speed of a moving object in a color image by using a Doppler effect. The M mode provides bio-information (such as luminance information) of certain part of the object changing according to time in an image in the B mode. The elastic mode provides an image of a reaction difference when compression is applied and not applied to the object.

**[0082]** The server 300 transmits the generated ultrasound image data to the electronic device 500 in operation S670 so as to display the ultrasound image on the display unit 520 of the electronic device 500. Furthermore, the server 300 transmits the various modes for processing the ultrasound image or manipulation menu information about controlling the probe device 100 to the electronic device 500 so that the user selects a mode for processing the ultrasound image and controls the probe device 100 by manipulating the electronic device 500.

**[0083]** The system described above may be employed in plurality of different scenarios. For example, an emergency rescuer may execute the image diagnostic application of the server 300 through the electronic device 500 in an emergency, and scan a predetermined part of a person to be examined by interlocking the probe device 100 with the image diagnostic application while looking at an ultrasound image displayed on the electronic device 500, thereby checking the person on the spot in real-time.

**[0084]** Alternatively, a doctor or a patient, i.e., a person to be examined, may execute the image diagnostic application of the server 300 through the electronic device 500 at the house of the patient, and scan a predetermined part of the person by interlocking the probe device 100 with the image diagnostic application while looking at an ultrasound image displayed on the electronic device 500, thereby checking the person on the spot in real-time.

**[0085]** Moreover, an image diagnostic expert in a hos-

pital may possess the probe device 100 and the electronic device 500, and diagnose a patient on the spot in real-time instead of a separate ultrasonic diagnostic room. Here, the ultrasound image obtained through the probe device 100 may be stored in the electronic device 500 and used for future diagnosis.

**[0086]** The probe device 100 and the plurality of electronic devices 500 connected to the server 300 may independently operate. In other words, one probe device 100 and one electronic device 500 may pair up to connect to the server 300. In this case, the server 300 may be placed at a hospital or in a data sensor, and an expensive apparatus for processing an ultrasound image may be replaced by the server 300, thereby reducing expenses for the system.

**[0087]** A cloud computing service denotes a service of providing computing resources requested by a user at any time anywhere through the Internet. In the cloud computing service, when a client requests to execute an application, a server executes the application and provides only a result to the client. In other words, the client may be considered as a type of input and output device in the cloud computing service. In the system of the current exemplary embodiment, since processing of an ultrasound image is separated from the probe device 100 and the electronic device 500, and performed by the ultrasound image diagnostic application of the server 300, the probe device 100 and the electronic device 500 may be understood as a type of client, and the server 300 may be understood as a cloud service server. High performance computing resources are required to obtain an ultrasound image and diagnostic results of high quality, but such a request for high performance computing resources is an obstacle to compact and reduce a thickness of the system. However, in the current exemplary embodiment, since the image diagnostic application for obtaining an ultrasound image from echo data is performed by the server 300, the probe device 100 may be compacted and slimmed down for portability, and thus an ultrasound image diagnostic service may be easily used at home and outdoors.

**[0088]** FIG. 7 is a block diagram of a probe device 101 according to another exemplary embodiment of the present invention. Referring now to FIG. 7, the probe device 101 according to the current exemplary embodiment is substantially identical to the probe device 100 of the previous embodiment, except that the probe device 101 further includes a transmitter beam former 122 in the pulse generator 120 and a receiver beam former 133 in the analog signal processor 130.

**[0089]** In the above exemplary embodiment, the server 300 performs the transmitter beam forming process and the receiver beam forming process, but in the current embodiment, the transmitter beam former 122 and the receiver beam former 133 included in the probe device 101 respectively perform the transmitter beam forming process and the receiver beam forming process. For example, the transmitter beam former 122 enables the

pulser 121 to generate pulse signals to be applied to each of the conversion elements of the transducer 110 by considering the locations of the conversion elements and the focus point of the ultrasonic waves. The receiver beam former 133 performs a process of focusing to view reflection characteristics of a tissue at a desired location from a received ultrasonic signal.

**[0090]** In the current exemplary embodiment, since the transmitter and receiver beam forming processes are performed by the probe device 101, data according to the transmitter and receiver beam forming processes do not need to be transmitted and received through the first network 200, and thus an amount of data transmitted and received in the probe communicator 150 may be reduced.

**[0091]** FIG. 8 is a block diagram of a probe device 102 according to another exemplary embodiment of the present invention. Referring to FIG. 8, the probe device 102 according to the current embodiment is substantially identical to the probe device 101 of FIG. 7, except that the probe device 102 further includes a compressor 134 in the analog signal processor 130. The compressor 134 compresses a data size of a digital echo signal generated by the analog signal processor 130.

**[0092]** In the previous exemplary embodiments, uncompressed echo data is transmitted to the server 300 from the probe devices 100 and 102, but the probe device 102 of the current exemplary embodiment transmits compressed data to the server 300. Thus, more pieces of information are substantially transmitted to the server 300 in real-time, and an ultrasound image having a high resolution may be obtained in real-time. A compression program can be used to compress the data.

**[0093]** FIG. 9 is a block diagram of a probe device 103 according to another embodiment of the present invention. Referring now to FIG. 9, the probe device 103 is substantially identical to the probe devices 100, 101, and 102 of the previous embodiments, except that the probe device 103 further includes a user input unit 160. The user input unit 160 may be a key input unit for manipulating the probe device 103. In some cases, the user input unit 160 may provide a user interface of the ultrasound image diagnostic application executed in the server 300. As such, since the probe device 103 additionally includes the user input unit 160, the probe device 103 may be manipulated by using the probe device 103 itself. The user input may also comprise a portion of the touchscreen.

**[0094]** FIG. 10 is a diagram of a system for diagnosing an ultrasound image, according to still another exemplary embodiment of the present invention.

**[0095]** Referring now to FIG. 10, the system according to the current exemplary embodiment includes the probe device 100, the server 300, a first electronic device 501, and a second electronic device 502. In the current exemplary embodiment one system is formed as the first and second electronic devices 501 and 502 are combined with respect to one probe device 100. Of course,

three or more electronic devices may be combined for one probe device 100. The first and second electronic devices 501 and 502 are substantially identical to the electronic device 500 described with reference to FIGS. 1 through 9, except that the first and second electronic devices 501 and 502 are combined to one probe device 100. In other words, mechanical structures of the first and second electronic devices 501 and 502 are substantially identical to that of the electronic device 500.

**[0096]** A cooperation relation between the first and second electronic devices 501 and 502 may vary.

**[0097]** For example, the ultrasound image diagnostic application executed in the server 300 may be controllable by any one of the first and second electronic devices 501 and 502. Alternatively, the ultrasound image diagnostic application may be controllable by both the first and second electronic devices 501 and 502. Since the ultrasound image diagnostic application not only generates the ultrasound image based on the echo signal from the probe device 100, but also controls the probe device 100, any one or both of the first and second electronic devices 501 and 502 may be used to control the probe device 100. Also, the ultrasound image or the user interface of the ultrasound image diagnostic application displayed on the first electronic device 501 may be manipulatable from the second electronic device 502 connected through the server 300, or alternatively, the ultrasound image or the user interface of the ultrasound image diagnostic application displayed on the second electronic device 502 may be manipulatable from the first electronic device 501 connected through the server 300.

**[0098]** For example, the first electronic device 501 may be adjacent to the probe device 100 and/or locally coupled to the first electronic device 501, and thus the first electronic device 501 may be connected to the server 300 and the ultrasound image diagnostic application of the server 300 may be executed before the operation of the probe device 100, i.e., before ultrasonic waves scan the person to be examined. For example, the probe device 100 and the first electronic device 501 may be operated by the same person. Meanwhile, the second electronic device 502 is remotely located from the probe device 100, i.e., the person to be examined, and the ultrasound image based on the echo signal obtained by the probe device 100 may be remotely viewed in real-time.

**[0099]** In more detail, the first electronic device 501 may be used by an emergency rescuer and the second electronic device 502 may be used by an image diagnostic expert at a hospital or the like. In this case, when the emergency rescuer executes the ultrasound image diagnostic application of the server 300 through the first electronic device 501 and scans a predetermined part of the person to be examined while interlocking the probe device 100 with the ultrasound image diagnostic application in an emergency, the remote image diagnostic expert may direct manipulation (for example, pointing out a part to be scanned) of the probe device 100 to the emergency rescuer through a communication unit such as a phone,

while looking at an ultrasound image on a screen of the ultrasound image diagnostic application executed by the server 300 through the second electronic device 502 in real-time. If the ultrasound image or the user interface of the ultrasound image diagnostic application displayed on the first electronic device 501 is manipulatable from the second electronic device 502, the image diagnostic expert may directly manipulate the ultrasound image or other data displayed on the first electronic device 501 through the second electronic device 502. A remote configuration programs can be used as one possible example for device 502 to manipulate device 501. Also, the image diagnostic expert may select a mode of the ultrasound image (for example, a B mode, a D mode, a C mode, or an elastic mode) by manipulating a manipulation menu of the ultrasound image diagnostic application executed in the server 300 through the second electronic device 502. A third electronic device may be further included for a third person to view the ultrasound image through the third electronic device.

**[0100]** Next, operations of the system according to the current embodiment will be described.

**[0101]** FIG. 11 is a flowchart illustrating a method of processing an ultrasound image, according to an exemplary embodiment of the present invention.

**[0102]** Referring now to FIGS. 10 and 11, the system of the current exemplary embodiment operates as follows. First, the first electronic device 501 connects to the server 300 in operation S710. The first electronic device 501 may be a terminal possessed by a medical image expert, such as a doctor, a nurse, a medical laboratory technologist, or an emergency rescuer, or a terminal possessed by a person to be examined. When a message requesting to execute the ultrasound image diagnostic application is transmitted from the first electronic device 501 to the server 300, the server 300 executes the ultrasound image diagnostic application in operation S720. User authentication may be performed when the first electronic device 501 is connected to the server 300 or when the ultrasound image diagnostic application is executed. Then, the probe device 100 is turned on, and is interlocked with the ultrasound image diagnostic application of the server 300, in operation S730. Then, the probe device 100 transmits digital echo data generated from reflected ultrasonic waves to the server 300 in operation S740. The ultrasound image diagnostic application of the server 300 generates ultrasound image data by using the echo data received from the probe device 100 in operation S750.

**[0103]** The server transmits the generated ultrasound image data to the first electronic device 501 in operation S760, and the ultrasound image is displayed on a display unit (refer to the display unit 520 of FIG. 4) of the first electronic device 501.

**[0104]** Meanwhile, the second electronic device 502 connects to the server 300 to execute the ultrasound image diagnostic application in operation S770. The second electronic device 502 may be remotely located from the

probe device 100.

**[0105]** For example, the probe device 100 and the first electronic device 501 may be located outdoors or at home and used by an amateur, such as a patient or an emergency rescuer, and the second electronic device 502 may be located at a hospital and used by an expert, such as a doctor. When the second electronic device 502 executes the ultrasound image diagnostic application, the ultrasound image diagnostic application transmits the ultrasound image based on the echo data obtained from the probe device 100 to the second electronic device 502, and the second electronic device 502 displays the ultrasound image in operation S780. Furthermore, the server 300 may provide the ultrasound image diagnostic application to the second electronic device 502 so as to allow the second electronic device 502 to control the ultrasound image diagnostic application executed in the server 300. In addition, user authentication may be additionally performed when the second electronic device 502 is connected to the server 300 or the second electronic device 502 executes the ultrasound image diagnostic application.

**[0106]** FIG. 12 is a diagram of a system for diagnosing an ultrasound image, according to another exemplary embodiment of the present invention.

**[0107]** Referring to FIG. 12, the system according to the current embodiment includes a probe device 105, a server 300, and an electronic device 500. In the current embodiment, the probe device 105 and the electronic device 500 are directly connected to each other and the probe device 105 connects to a network 400 through the electronic device 500. The probe device 105 includes a communication interface connectable to the electronic device 500, and may not include a communication module that directly connects to the network 400. As such, by using the communication interface that is low-priced, is light weighted, and has low power consumption instead of a high-priced communication module for the probe device 105, manufacturing costs of the probe device 105 may be reduced, a weight of the probe device 105 may be decreased, and power consumption of the probe device 105 may be decreased, thereby improving portability of the probe device 105.

**[0108]** The server 300 and the electronic device 500 of FIG. 12 may respectively be the server 300 and the electronic device 500 of FIGS. 3 and 4. The current embodiment is substantially identical to those described with reference to FIGS. 1 through 9, except that the probe device 105 connects to the network 400 through the electronic device 500.

**[0109]** For example, a probe communicator of the probe device 105 and a terminal communicator of the electronic device 500 may include a communication interface, such as a USB or a Bluetooth, and only the electronic device 500 may include a mobile communication module, a wired Internet module, a wireless Internet module, or a local area communication module, which connects to the network 400. In this case, the probe device

105 connects to the electronic device 500 wirelessly or via wires, and may connect to the server 300 through the electronic device 500.

**[0110]** FIG. 13 is a diagram of a system for diagnosing an ultrasound image, according to another exemplary embodiment of the present invention.

**[0111]** Referring to FIG. 13, the system according to the current embodiment includes a probe device 105, a server 300, a first electronic device 501, and a second electronic device 502. In the current embodiment, the probe device 105 and the first electronic device 501 are directly connected to each other, and the probe device 106 connects to the server 300 on a network 400 through the first electronic device 501. Also, the second electronic device 502 connects to the server 300 through the network 400. Of course, an electronic device may additionally connect to the server 300 through the network 400. The current embodiment is substantially identical to those described with reference to FIGS. 10 and 11, except that the probe device 105 connects to the network 400 through the first electronic device 501. Meanwhile, the first electronic device 501 may simply function only as a communication module of the probe device 105. In this case, the first electronic device 501 may be understood to be an external type of the probe communicator 150 of the probe device 100 described above with reference to FIG. 2.

**[0112]** According to the systems and the methods of the exemplary embodiments of the present invention, a high load image process is focused on the server such that the probe device or the electronic device does not require a high performance processing apparatus. Thus, the probe device or the electronic device can be compacted and slimmed down to improve portability and reduce manufacturing costs.

**[0113]** In the case where the first device and/or the second device may both constitute a mobile communication terminal, such as a user in a remote area using a probe 100 attached to or integrated with device 95 to provide the information to a medical expert via the second electronic device 500, the person probing and the medical expert can make or receive telephone communications to the person self-probing or being probed locally while a user of the second electronic device or another communication device may provide verbal feedback or instructions to the user of the device 95 instead of or in addition to the second electronic device manipulating the device 95. Such an exemplary embodiment is advantageous as the first user may not be a trained ultrasound technician and can receive instructions while directing the probe, for example, when the device has a speakerphone turned on. A person of skill in the art can appreciate that as some mobile communication terminals can access the Internet while making a voice call, which may or may not include voice over IP (VOIP), and the ultrasound can be activated and relaying results via a server or base station while speaking with a doctor, ultrasound technician, emergency medical member, which may be

critically advantageous in the case of a serious injury. Also, according to the systems and the methods of the exemplary embodiments of the present invention, the time taken to start diagnosis by using high performance computing resources of the server is reduced, and thus a patient can be quickly diagnosed.

**[0114]** In addition, according to the systems and methods of the exemplary embodiments of the present invention, the user is able to view progress of a corresponding application by connecting to the system through the electronic device connected to the network, and thus spatial limitation is reduced and a limitation to a number of displays is reduced.

**[0115]** The above-described methods according to the present invention can be implemented in hardware, firmware or as software or computer code that is loaded into hardware such as a microprocessor and can be stored in a recording medium such as a CD ROM, an RAM, flash drive, a floppy disk, a hard disk, or a magneto-optical disk or computer code downloaded over a network originally stored on a remote recording medium or a non-transitory machine readable medium and to be stored on a local recording medium, so that the methods described herein can be rendered in such software that is stored on the recording medium using a general purpose computer and loaded into hardware such as a processor or microprocessor, or a special processor or in programmable or dedicated hardware, such as an ASIC or FPGA. As would be understood in the art, the computer, the processor, microprocessor or controller are hardware elements and the claims are to be interpreted with such elements comprising hardware, and not to be interpreted under the broadest reasonable interpretation as being pure software that is outside the scope of a statutory invention. The programmable hardware include memory components, e.g., RAM, ROM, Flash, etc. that may store or receive software or computer code that when accessed and executed by the computer, processor or hardware implement the processing methods described herein. In addition, it would be recognized that when a general purpose computer accesses code for implementing the processing shown herein, the execution of the code transforms the general purpose computer into a special purpose computer for executing the processing shown herein.

**[0116]** The invention can also be embodied as computer readable codes on a computer readable recording medium. The computer readable recording medium is any data storage device that can store data which can be thereafter read by a computer system. Examples of the computer readable recording medium include read-only memory (ROM), random-access memory (RAM), CD-ROMs, magnetic tapes, floppy disks, optical data storage devices, etc. The computer readable recording medium can also be distributed over network coupled computer systems so that the computer readable code is stored and executed in a distributed fashion. Moreover, all of the modules described herein constitute hardware

modules that such as microprocessors that can be configured with software or firmware, as the claimed invention in accordance with the appended claims are directed to statutory subject matter.

**[0117]** While the present invention has been particularly shown and described with reference to exemplary embodiments thereof, it will be understood by those of ordinary skill in the art that various changes in form and details may be made therein without departing from the spirit and scope of the present invention as defined by the following claims.

## Claims

### 1. A probe device comprising:

a pulse generator comprising a pulser configured to generate a pulse signal;  
a transducer configured to convert the generated pulse signal into ultrasonic waves for transmission toward a body, and to convert ultrasonic waves that are reflected back from the body into an electrical signal;  
a signal processor for generating an echo signal of the electrical signal converted from the reflected ultrasonic waves by the transducer; and  
a probe communicator that is configured for communicating through a network with a server configured to execute an ultrasound image diagnostic application requested by an electronic device, wherein the probe communication is configured to transmit the echo signal generated by the signal processor to the server.

2. The probe device of claim 1, wherein the probe communicator comprises at least one of a mobile communication module directly connecting to the network, a wireless Internet module, a wired Internet module, and a local area communication module, or comprises a communication interface connecting to the network through an external communication module.

3. The probe device of claim 1 or 2, further comprising a user input unit is configured to receive input commands.

4. A server configured for an ultrasound diagnostic system, said server comprising:

a server communicator configured to communicate with an ultrasound probe device of any one of claims 1 to 3 and an electronic device through a network;  
a data storage unit that stores an ultrasound image diagnostic application; and  
an operation unit configured to execute the ul-

- trasound image diagnostic application in response to a request by the electronic device, wherein the operation unit is configured to generate ultrasound image data utilizing an echo signal transmitted from the electronic device, and to transmit the generated ultrasound image data to the electronic device.
- 5
12. The system of any one of claims 5 to 11, wherein the electronic device comprises a mobile terminal connected to a wireless network or a desktop connected to a wired or wireless network.
- 10
13. A method of processing an ultrasound image through a system of any one of claims 5 to 12, the method comprising:
- 15
- transmitting from the electronic device to the server a request for executing an ultrasound image diagnostic application through a network; executing the ultrasound image diagnostic application by using the server in response to the request from the electronic device; generating an echo signal of a material to be examined by the probe device; transmitting the echo signal generated by the probe device to the server; generating ultrasound image data by the server using the echo signal received; and displaying an ultrasound image on the electronic device generated by the ultrasound image data received from the server through the network.
- 20
14. The method of claim 13, wherein the generating of the echo signal further comprises compressing a data size of the digital echo signal.
- 25
15. The method of claim 13 or 14, further comprising displaying in the electronic device a user interface of the ultrasound image diagnostic application executed by the server and output to the electronic device.
- 30
- 35
- 40
- 45
- 50
- 55
6. The system of claim 5, wherein the probe device is configured to perform a receiver beam forming process that focuses the echo signal; or wherein the ultrasound image diagnostic application executed by the server is configured to execute a transmitter beam forming process that focuses the echo signal.
7. The system of claim 5, wherein the probe device is configured to perform a receiver beam forming process that focuses the echo signal; or wherein the ultrasound image diagnostic application executed by the server is configured to execute a receiver beam forming process that focuses the echo signal.
8. The system of any one of claims 5 to 7, wherein the probe device and the electronic device are configured in such a way that operation of the probe device is controllable by the electronic device.
9. The system of any one of claims 5 to 8, wherein the electronic device comprises a first electronic device and a second electronic device, which are configured to respectively receive and display ultrasound image data generated by the ultrasound image diagnostic application of the server.
10. The system of claim 9, wherein the ultrasound image diagnostic application executed by the server is controlled by at least one of the first and second electronic devices.
11. The system of claim 9, wherein the first and second electronic device are configured in such a way that the ultrasound image data or the user interface of

FIG. 1

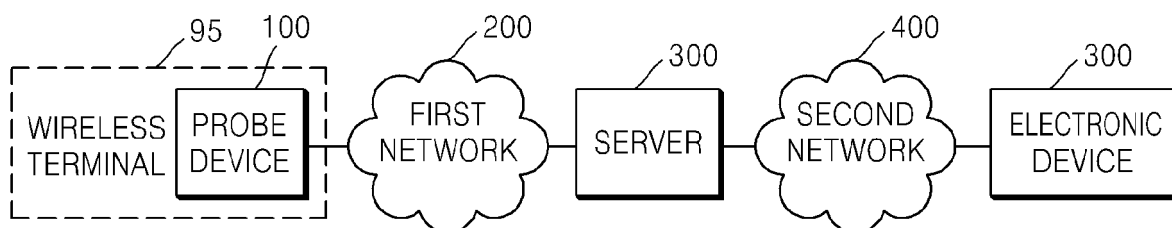


FIG. 2

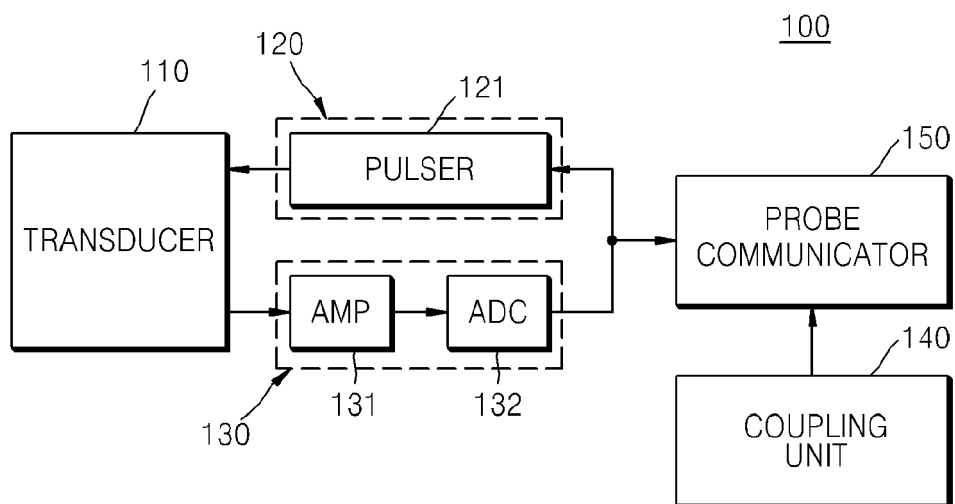


FIG. 3

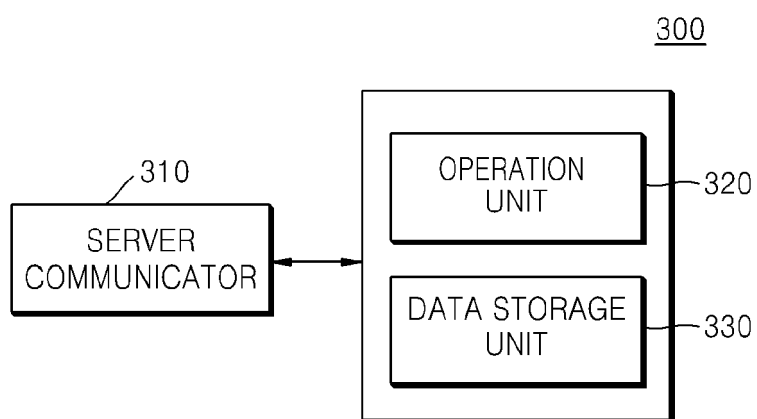


FIG. 4

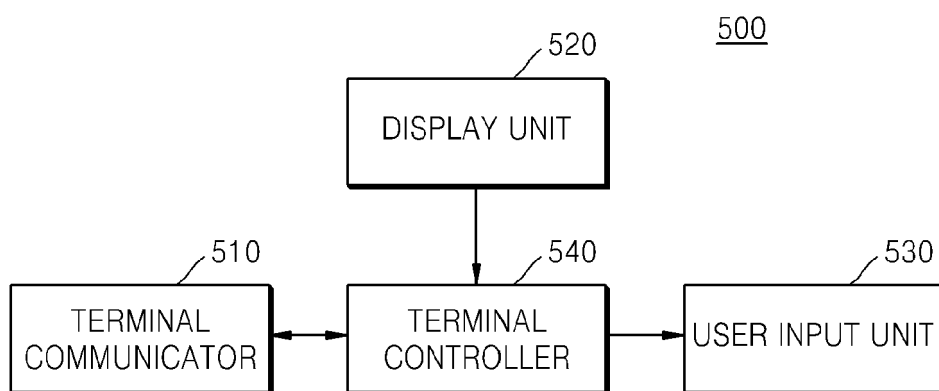


FIG. 5

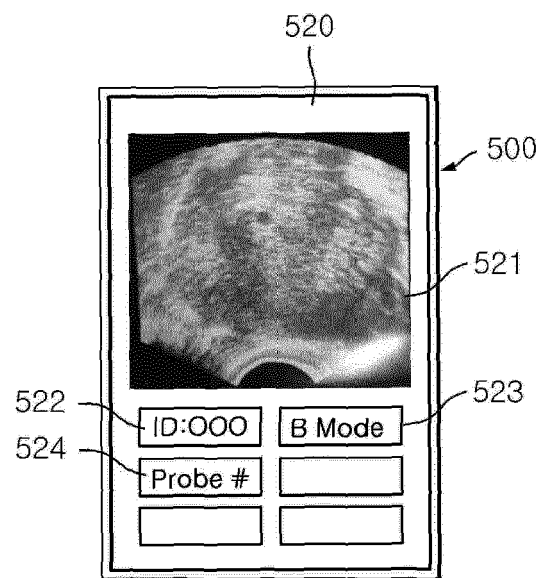


FIG. 6

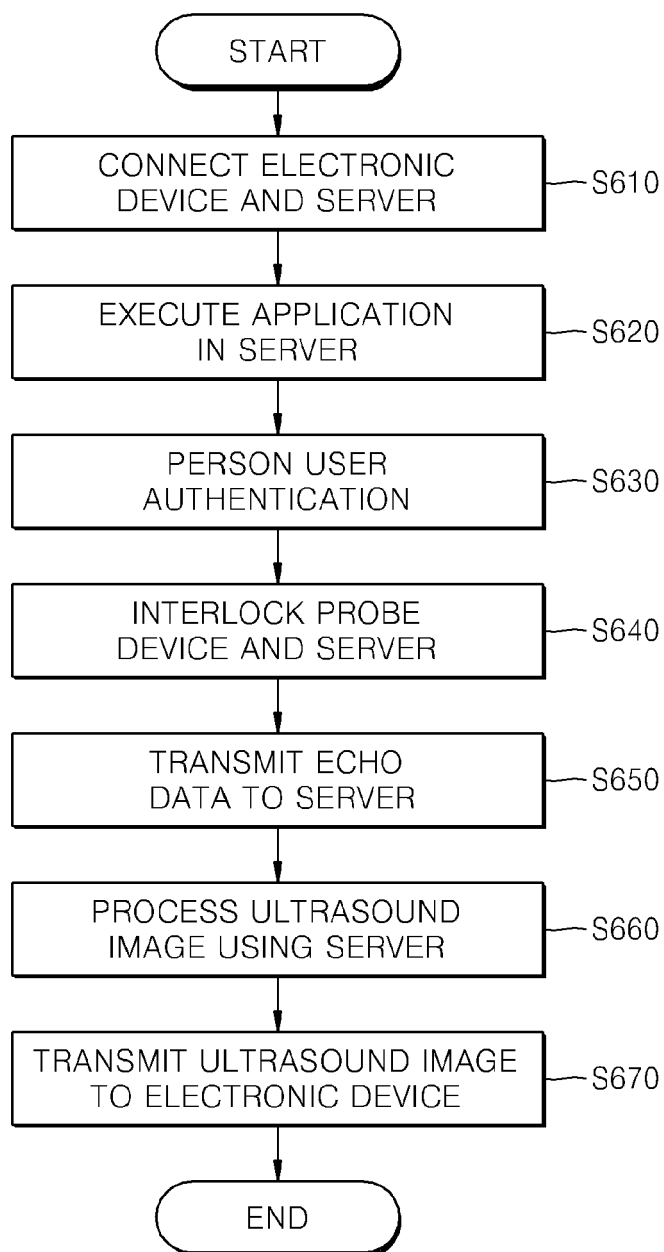


FIG. 7

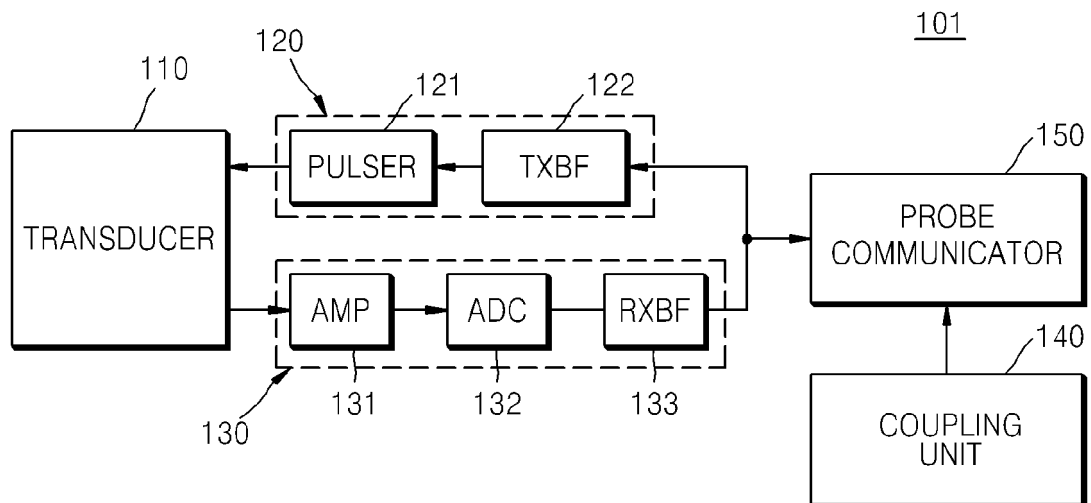


FIG. 8

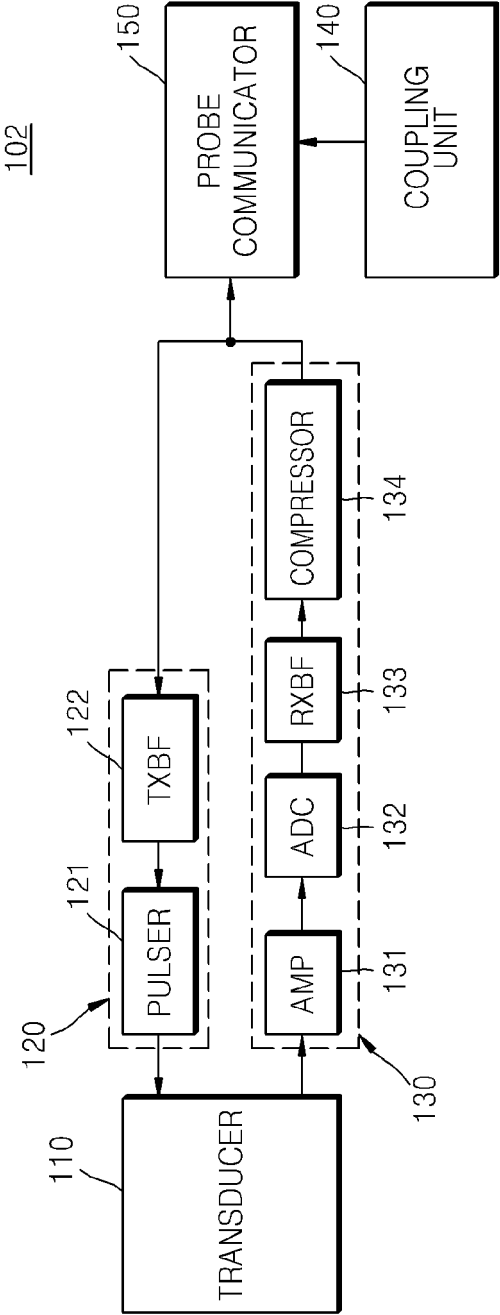


FIG. 9

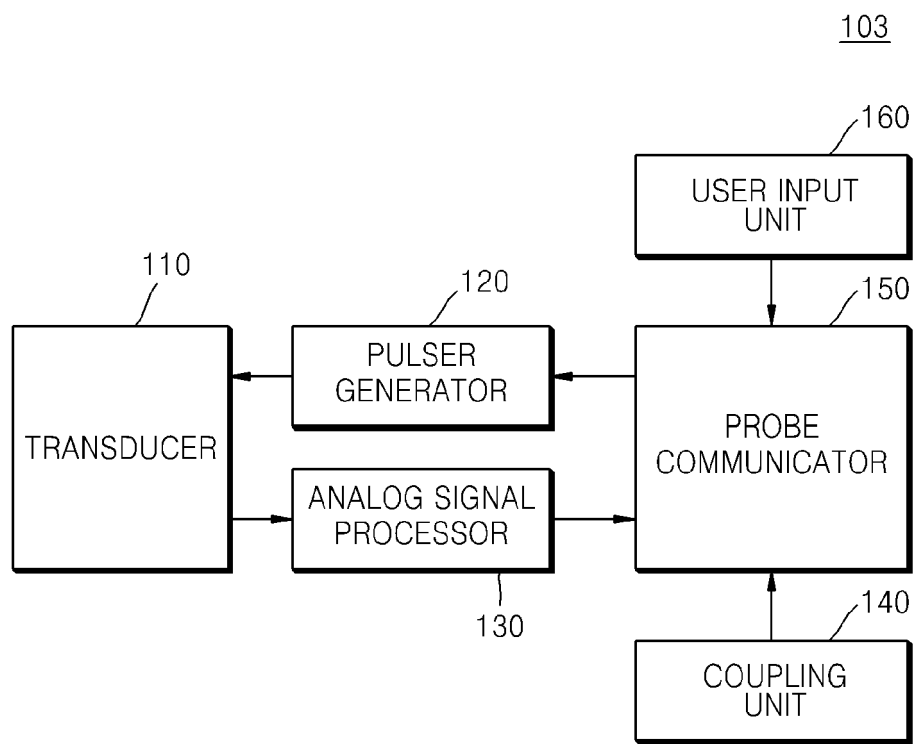


FIG. 10

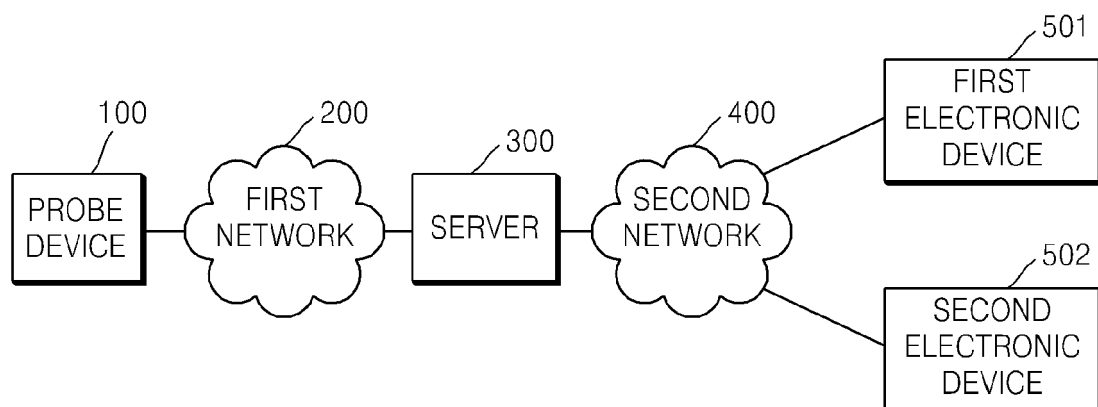


FIG. 11

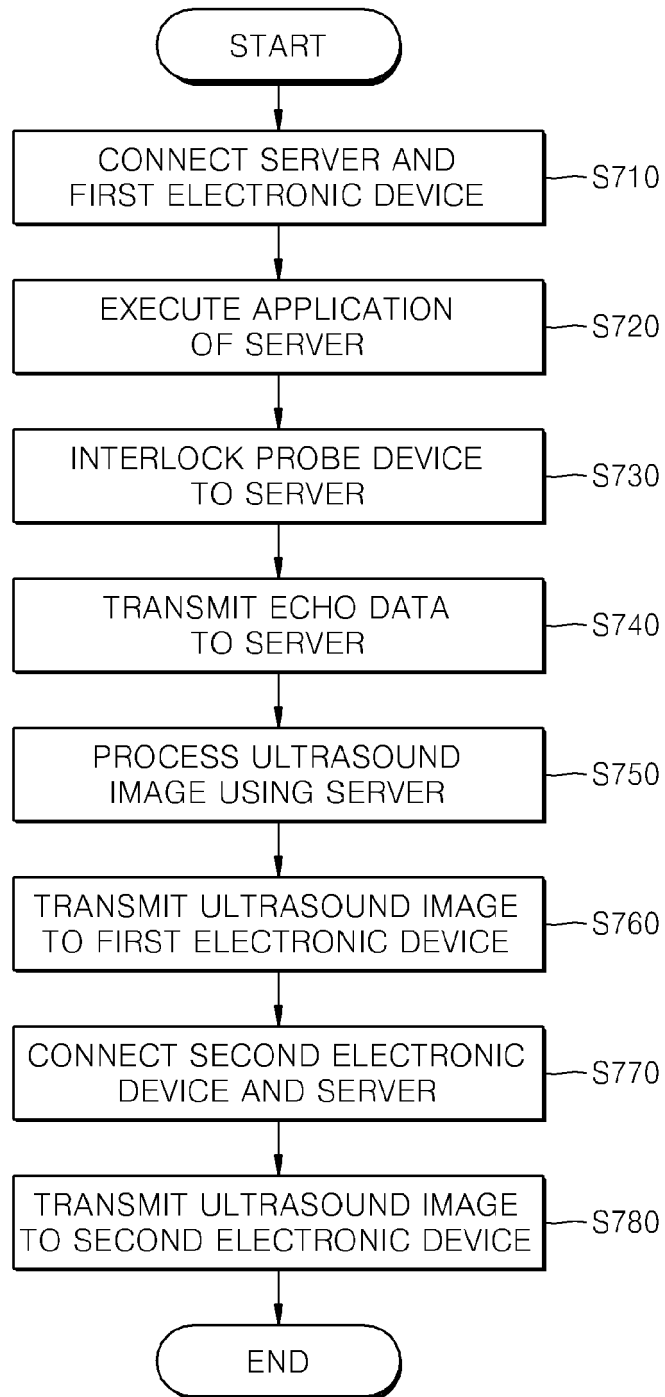


FIG. 12

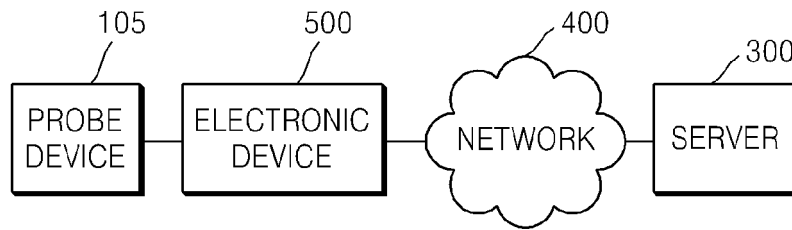
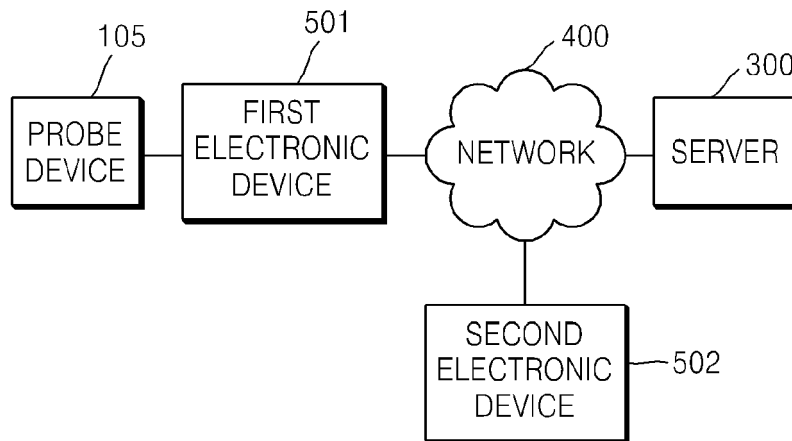


FIG. 13





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Application Number  
EP 13 15 1625

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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			A61B G06F
Place of search		Date of completion of the search	Examiner
Munich		22 April 2013	Koprinarov, Ivaylo
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**ANNEX TO THE EUROPEAN SEARCH REPORT  
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EP 13 15 1625

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22-04-2013

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82